MICHIGAN DEPARTMENT OF NATURAL RESOURCES & ENVIRONMENT

INTEROFFICE COMMUNICATION

TO: File

FROM: DW David Worthington, Project Manager

DATE: March 2, 2011

SUBJECT: State Revolving Fund (SRF) Project No. 5454-01
City of Grand Rapids Project Plan
Green Project Reserve (GPR) Qualifying Costs

In the Part III Application for the above-referenced project, bid information was obtained to determine the final qualifying GPR amounts for inclusion in the Order of Approval package.

The following items are GPR eligible from the bid proposal of the successful low bidder (Franklin Holwerda Company) on the North Secondary Treatment System Improvements:

Bid Item 2 – North Aeration Selector Zone -	$1,410,000
Bid Item 3 – North Aeration Fine Bubble Aeration Modifications -	$ 400,000
Bid Item 5 – Mechanical Improvements for Transfer of Excess Heat from North Blower Building to North Secondary Control Building -	$ 135,000
Total	$1,945,000

Bid Items 2 and 3 are essential to provide biological phosphorus removal in the North Secondary Treatment System. It is a green technology that eliminates the use of chemicals (ferrous chloride). Bid Item 5 is an energy efficiency effort that will result in 100 percent energy savings (use of waste heat to replace natural gas heating).

Attached is a copy of the bid proposal. Total eligible construction costs for this project = $4,681,216. Therefore, the percentage of green construction is $1,945,000 ÷ $4,681,216 = .4155. Since the SRF loan amount is $6,000,000, the total green costs (construction and non-construction) are $6,000,000 x .4155 = $2,493,000.

Because 50 percent of the GPR eligible costs qualify for "principal forgiveness," the maximum amount usable for this purpose is $2,493,000 multiplied by 50 percent = $1,246,500.

Please note that eligibility of the three GPR items was documented in a July 21, 2010, business case letter submitted by Mr. Jeff Glover of Black & Veatch on Grand Rapids' behalf and supported by Mr. Richard Sadowski of the Grand Rapids District Office, Water Bureau, in his memorandum to me dated September 23, 2010, as included in the official project file.

Attachment

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fTC&h
Fishbeck, Thompson, Carr & Huber
MOORE & BRUGGINK, INC.
Consulting Engineers

July 21, 2010
B&V Project No. 166310

Mr. David J. Worthington
DNRE-Water Bureau
Revolving Loan Programs
Constitution Hall
525 West Allegan
P.O. Box 30457
LANSING MI 48933-1502

Re: Green Project Reserve
Clean Water Revolving Fund (CWRF)
City of Grand Rapids
CWRF No. 5454-01

Dear Mr. Worthington:

This letter is a follow-up to the previous Green Project Reserve (GPR) letter sent on June 29, 2010. This letter incorporates MDNRE comments received on July 14, 2010 and presents an updated business case for consideration of the North Secondary Treatment Improvements Project at the Grand Rapids Wastewater Treatment Plant for Green Project Reserve funding.

Portions of this project convert the existing chemical phosphorus treatment system to a biological phosphorus removal system. These portions of the project are being submitted under the Environmentally Innovative Section 4.0, specifically paragraph 4.5-5 of the Guidance Document, as a project that significantly reduces the use of chemicals (iron in the form of ferrous chloride) in the wastewater treatment plant. As a secondary environmentally innovative benefit, reduced chemical usage will reduce the volume of residuals, and lower the amount of chemicals in the residuals, as iron will no longer be used to chemically remove phosphorus.

A separate portion of this project converts the North Blower and Secondary Control Buildings heating systems to reuse waste heat from the aeration blowers to heat the buildings. This project component provides energy savings in excess of 20 percent versus the current system and is being submitted under the Energy Efficiency Section 3.0, specifically paragraph 3.2-2 of the Guidance Document, as a project that achieves at least a 20% reduction in energy consumption, and therefore a business case for the portion of the project is not required.

Background
The project was reviewed in detail in the *North Secondary Treatment Improvements Preliminary Design Report* (Tetra Tech, Inc. 2009) and costing information is detailed in the CWRF Project Plan. The preliminary design report details the basis of design for conversion of the existing chemical phosphorus removal system to a biological phosphorus removal system. The project will provide a biological phosphorus removal system that will lower sludge quantities and reduce the use of chemicals drastically at the wastewater treatment plant.

The project includes the following components which are integral to the purpose of upgrading the existing equipment and structures to a biological phosphorus removal system and are presented for green project reserve funding consideration:

- Installation of a selector zone in the north aeration tanks.
- Fine bubble diffuser aeration modifications in the north aeration tanks.

Your July 14, 2010 letter asked for additional information regarding the aeration diffuser modifications, related to determining if these modifications are essential to the selector zone improvements and thus the biological phosphorus removal system. These modifications are an essential component toward

implementing the selector zone improvements. The selector zone improvements consist of the addition of walls constructed inside of the existing basins to allow for an area of anaerobic treatment prior to aeration. The walls constructed will enclose the selector zone which will occupy 23% of the area inside the aeration basins. The diffusers already installed in the selector zone areas must be removed to install the selector zone, and the diffuser arrangement must be modified to implement effective aeration in the smaller area. Since this work is essential to the biological phosphorus removal process and thus will significantly reduce chemical usage, both the selector zone improvements and the aeration diffuser modifications are eligible for GPR funding.

The project includes the following components which provides an energy savings in excess of 20 percent versus current technology and is presented for green project reserve funding consideration:

- Reuse of waste heat from the blowers for heating the North Blower and Secondary Control Buildings.

Also, the following components are part of the project, however, they are not essential components of the biological phosphorus removal process and therefore are not applicable to green project reserve funding consideration:

- Influent channel mixing addition prior to north aeration.
- North secondary treatment building architectural improvements
- North return activated sludge control valve replacement.
- Secondary clarifier mechanism replacement.

Lastly, note that after issue of the *North Secondary Treatment Improvements Preliminary Design Report* (Tetra Tech, Inc. 2009) some of the project components were deleted from the design by the Owner for various reasons. These deleted items include the aeration blower modifications (replacement blowers), and the primary tank channel mixing. These project components are not essential components of the biological phosphorus removal process. The original project basis as indicated in the Preliminary Design Report, when it included replacement blowers, would have made a net reduction in greenhouse gases for the total project, which would have been satisfied other criteria listed for GPR funding. Since the replacement blowers were eliminated from the project, the project as currently configured does not provide a reduction in greenhouse gases, as that reduction was due to more efficient blowers being installed that would have offset the additional energy consumed by the mixing added to the anaerobic selector zone. Although greenhouse gas reduction is not occurring, the biological phosphorus removal upgrades do qualify for GPR funding under the Environmentally Innovative Section 4.0 of the Guidance Document as described in this business case.

Reduced Chemical Usage from Biological Phosphorus Removal Conversion

The combination of addition of the anaerobic selector zone and fine bubble diffuser modifications in the north aeration tanks will provide approximately 5-6 mg/l reduction in total phosphorus with biological phosphorus removal without the use of chemicals. The current process uses ferrous chloride to chemically precipitate phosphorus for removal. For an average of 5 mg/l for the phosphorus removal rate, the north secondary treatment system currently uses about 875,000 lbs of iron per year (in the form of ferrous chloride solution) to chemically precipitate and remove the phosphorus, based on an average annual flow of 24 MGD and a dosage of 12 mg/l. The average annual flow is based upon splitting the average annual flow half to the South and half to the North Secondary Treatment System. The dosage is based upon current dosages, and the phosphorus removal rate is based on the removal rate seen in the South Secondary Treatment System, which was improved in 2004 to be a biological phosphorus removal system.

Conversion to biological phosphorus removal will reduce the use of ferrous chloride by the amount of 875,000 lbs of iron per year. The energy expended to transport this amount of chemical, deliver it from

the chemical storage area to the basins for treatment, and the energy expended to treat and transport the iron sludge produced through the use of this chemical will be eliminated by this project.

Cost Savings for Biological Phosphorus Removal Conversion
The combination of addition of the anaerobic selector zone and fine bubble diffuser modifications in the north aeration tanks will provide approximately 5-6 mg/l reduction in total phosphorus without the use of chemicals. The current process uses ferrous chloride to chemically precipitate phosphorus for removal. For an average of 5 mg/l for the biological removal rate, the potential average chemical cost savings would be approximately $350,000 a year for an average annual flow of 24 MGD based on a dosage of 12 mg/l and current cost for iron of approximately $0.40 per pound. The cost of ferrous chloride is expected to double for the next contract pricing renewal, therefore the potential chemical costs savings would increase to approximately $700,000 per year with the implementation of biological phosphorus removal.

The reduction of ferrous chloride added for phosphorus removal in the system would also potentially reduce the required cleaning of the UV system bulbs downstream of the north secondary treatment system. The expected cleaning routine could be reduced from bi-weekly to every 8 weeks without the presence of ferrous chloride. This potential labor savings for the reduced cleaning cycle would be approximately $33,000 a year.

The cost of the combination of addition of the anaerobic selector zone and fine bubble diffuser modifications portions of the North Secondary Treatment Improvements project as presented in the CWRF is $2,586,400 and includes $2,063,000 for construction cost, $146,400 for contingency, $129,000 for design engineering and $248,000 for construction engineering, administration, and inspection. The 20-year present worth for the initial capital cost ($4,263,863) of the combination of addition of the anaerobic selector zone and fine bubble diffuser modifications portions of the North Secondary Treatment Improvements project is less than the 20-year present worth O&M cost considering the reduced chemical usage and reduced UV system bulb cleaning resulting from reduced chemical usage ($9,785,000). The payback period, that is the project cost ($2,586,400) divided by the cost savings for reduced chemical usage ($588,000 per year), is 4.4 years for this work.

Energy Efficiency - Waste heat from the blowers for heating the North Blower and Secondary Control Buildings
The potential to use the waste heat from the blowers to heat the North Blower and Secondary Control Buildings was evaluated in the Tetra Tech Design Report. It was found that the waste heat from one operating blower would be sufficient heat to meet the heating needs for the North Blower and Secondary Control Buildings. The air from one of the Blower Building exhaust fans could be routed through duct to the North Secondary Control Building. Controls and an inline fan would need to be installed as well for the system. The construction cost is $68,750 for these improvements. Use of the waste heat would completely replace the heating cost for the buildings, which is $18,000 per heating season, resulting in a 100% energy savings for heating these facilities. The payback period, that is the construction cost ($70,000) divided by the cost savings for reduced natural gas heating ($18,000 per year), is 3.8 years for this work.

Conclusion
In summary, based on these analyses, we request consideration for the Green Project Reserve (GPR) per FY 2010 Appropriations Law (P.L. 111-88) for the biological phosphorus removal portions of the North Secondary Treatment Improvements project as an Environmentally Innovative category project and for the waste heat reuse portion of the project as an Energy Efficiency category project.

We understand that items which are determined to be GPR qualifying will need to be identified as separate items in a bid proposal and not lumped in with the non-qualifying items.

BLACK & VEATCH
Building a world of difference.

fTCH
Fishbeck, Thompson, Carr & Huber
engineers • scientists • architects • constructors

MOORE & BRUGGINK, INC.
Consulting Engineers

Sincerely,
BLACK & VEATCH

Jeff A. Glover, P.E.
Project Engineer

Attachments: Project Cost Calculations
cc: Mr. Breese Stam, P.E. – City of Grand Rapids
Mr. David Koch, P.E. – Black & Veatch

State Revolving Fund (SRF) Project No. 5454-01
North Secondary Treatment System
Grand Rapids Wastewater Treatment Project Plan
Green Project Reserve (GPR) Business Case

July 21, 2010

These calcualtions respond to comments from a July 14, 2010 letter from MDNRE

Question #1: Provide calculation of payback period for the cost savings associated with the biological phosphorus removal.

		Formulas
Annual O&M Cost for current chemical phosphorus removal is =	$744,000	A
Annual O&M Cost for biological phosphorus removal is = (This cost is the energy cost for mixing within the selector zone)	$156,000	B

Detailed costs breakdowns for the above numbers are as described in the attached cost estimate backups from the Project Plan.

The difference in annual O&M Cost between the current system and the proposed biological phosphorus removal is =	$588,000	A-B

It is important to note that the aeration diffuser modifications mentioned in Questions #2 of the MDNRE July 14, 2010 letter are an essential component toward implementing the selector zone improvements. The selection zone improvements are constructed inside of the existing basins and will occupy 23% of the area inside the aeration basins. The diffusers already installed in the selector zone areas must be removed to install the selector zone, and the diffuser arrangement must be modified to implement effective aeration in the smaller area. Since this work is essential, the payback period should reflect the aeration diffuser modification costs.

The project cost for selector zone and the aeration diffuser modifications portion of the total project.	$2,586,400	C

Detailed cost breakdown for the project cost are included in the cost estimate backup portion of the project plan. (Excerpt Attached)

The payback period on the project considering the project cost of the selector zone portion and the aeration diffuser modifications portion is the total project cost divided by the annual O&M cost savings.	**4.4 years**	C/(A-B)

Biological Phosphorus Removal Project Component Costs

Table X-X
Estimated Project Cost Summary for North Secondary Treatment Improvements Alternative

Item	Initial Estimates Capital Cost	Design Life (years)	Salvage Value
North Aeration Improvements - Selector Zone	$1,462,000	50	$877,200
North Aeration Improvements - Fine Bubble Aeration Modifications	$601,000	20	$0
Design Engineering	$129,000		
CE/I/Admin (12%)	$248,000		
Contingency (6%)	$146,400		
Subtotal - Estimated Project Budget	$2,586,400		

Table X-X
Present Worth Analysis for North Secondary Treatment Improvements Alternative

Component	North Secondary Treatment Improvements		No Action	
	Actual Cost	20-year Present Worth	Actual Cost	20-year Present Worth
Initial Capital Cost	$2,586,400	$2,586,400	$0	$0
Annual O&M Cost	$156,000	$2,050,000	$744,000	$9,785,000
Salvage Value	$877,200	($372,537)	$0	$0
Total 20-year Present Worth Estimate		$4,263,863		$9,785,000

Complete Project (Including non-fundable Portions)
Cost Summary from CWRF Project Plan

Table 3-8

Estimated Project Cost Summary for North Secondary Treatment Improvements Alternative

Item	Initial Estimates Capital Cost	Design Life (years)	Salvage Value
Clarifier Mechanism Replacement	$2,734,000	20	$0
North Aeration Improvements - Selector Zone	$1,462,000	50	$877,200
North Aeration Improvements - Fine Bubble Aeration Modifications	$601,000	20	$0
North Aeration Improvements - Influent Channel Mixing	$157,000	20	$0
North Secondary Building - Architectural and Mechanical Improvements	$155,000	30	$51,667
North RAS Control Valve Replacement	$490,000	20	$0
Design Engineering	$349,000		
CE/I/Admin (12%)	$675,000		
Contingency (6%)	$397,000		
Subtotal - Estimated Project Budget	$7,020,000		

subtotal $2,063,000

waste heat subtotal $68,750

Subtotal of Bio-Phosphorus Portions 129,000 + 248,000 + 146,400 = 2,586,400

subtotal $5,599,000

No Action Alternative

The No Action Alternative has additional associated operational costs due to continued use of chemicals for phosphorus removal, while the North Secondary Treatment Improvements alternative converts to biological phosphorus removal providing a significant cost savings.

Present Worth Analysis

Sunk costs are not included in the analysis. Sunk costs include any investments or financial commitments made before or during the project planning. These costs include the cost of the existing facilities, land, outstanding bond indebtedness, etc. Day-to-day operation costs are not assumed to vary significantly from the alternatives. Table 3-7 shows the present worth analysis for the alternatives.

Waste Heat Reuse Costs

OPINION OF PROBABLE CONSTRUCTION COST

TETRA TECH

1921 East Miller Road Suite A, Lansing, MI 48911 Telephone: (517) 394-7900 FAX: (517) 394-001

PROJECT: North Secondary Plant Improvements
LOCATION: Grand Rapids, MI
BASIS FOR ESTIMATE: [ ] CONCEPTUAL [ ] PRELIMINARY [ ] FINAL
WORK: Secondary Building Architectural and Mechanical Improvements

DATE: 6/8/2009
PROJECT NO. 200-12737-09003
ESTIMATOR: MJB
CHECKED BY:
CURRENT ENR:

ITEM NO.	DESCRIPTION	QUANT.	UNIT	UNIT AMOUNT	TOTAL AMOUNT
1					
2	Blower Building HV Modifications				
3	In-line Centrifugal Exhaust Fan, 11,200 cfm, 7.5 hp	1	ea	$7,900.00	$7,900.00
4	36" Galv. Steel Transfer Duct (Blower Bldg. to Secondary Bldg.)	2,500	lb	$7.10	$17,750.00
5	Transfer Air Register	1	ea	$150.00	$150.00
6	Temperature Control Modifications	1	ls	$2,500.00	$2,500.00
7	Core into Exist. Outside Wall for New Duct w/Link Seal	1	ls	$300.00	$300.00
8	Ductwork Supports Between Buildings	13	ls	$300.00	$3,900.00
9	Insulation on Ductwork Located Outdoors	990	sf	$6.30	$6,237.00
10	Electrical	1	ls	$4,000.00	$4,000.00
11					
12	North Secondary Treatment Building HV Modifications				
13	Various Size Galvanized Ductwork to Chlorine Room,				
14	Basement, and First Floor	750	lb	$7.10	$5,325.00
15	Core into Exist. Outside Wall for New Duct w/Link Seal	1	ea	$300.00	$300.00
16	Miscellaneous Cores through Chlorine Room Wall and Basement	2	ea	$150.00	$300.00
17	Supply Air Registers	3	ea	$75.00	$225.00
18	Gravity Relief Vent w/Gravity Damper	1	ea	$400.00	$400.00
19	Wall Sawcutting for Relief Vent	1	ea	$250.00	$250.00
20					
21	Subtotal HV Modifications				$50,000.00
22					
23	~~Architectural Improvements~~	~~1~~	~~LS~~	~~$25,000.00~~	~~$35,000.00~~
24					
25	General Requirements	10	%	$5,000	~~$8,500.00~~
26	TOTAL CONSTRUCTION COST			$55,000	~~$93,500.00~~
27					
28	Engineering	10	%	$5,500	~~$9,350.00~~
29	Contingencies	15	%	$8,250	~~$14,025.00~~
30					
31					
	TOTAL PROJECT COST				~~$117,000.00~~

project cost = $68,750

payback period = $\frac{\text{project cost}}{\text{annual heating cost savings}} = \frac{\$68,750}{\$18,000} = 3.8$ years